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Economic Value of Campground Visits in Arizona

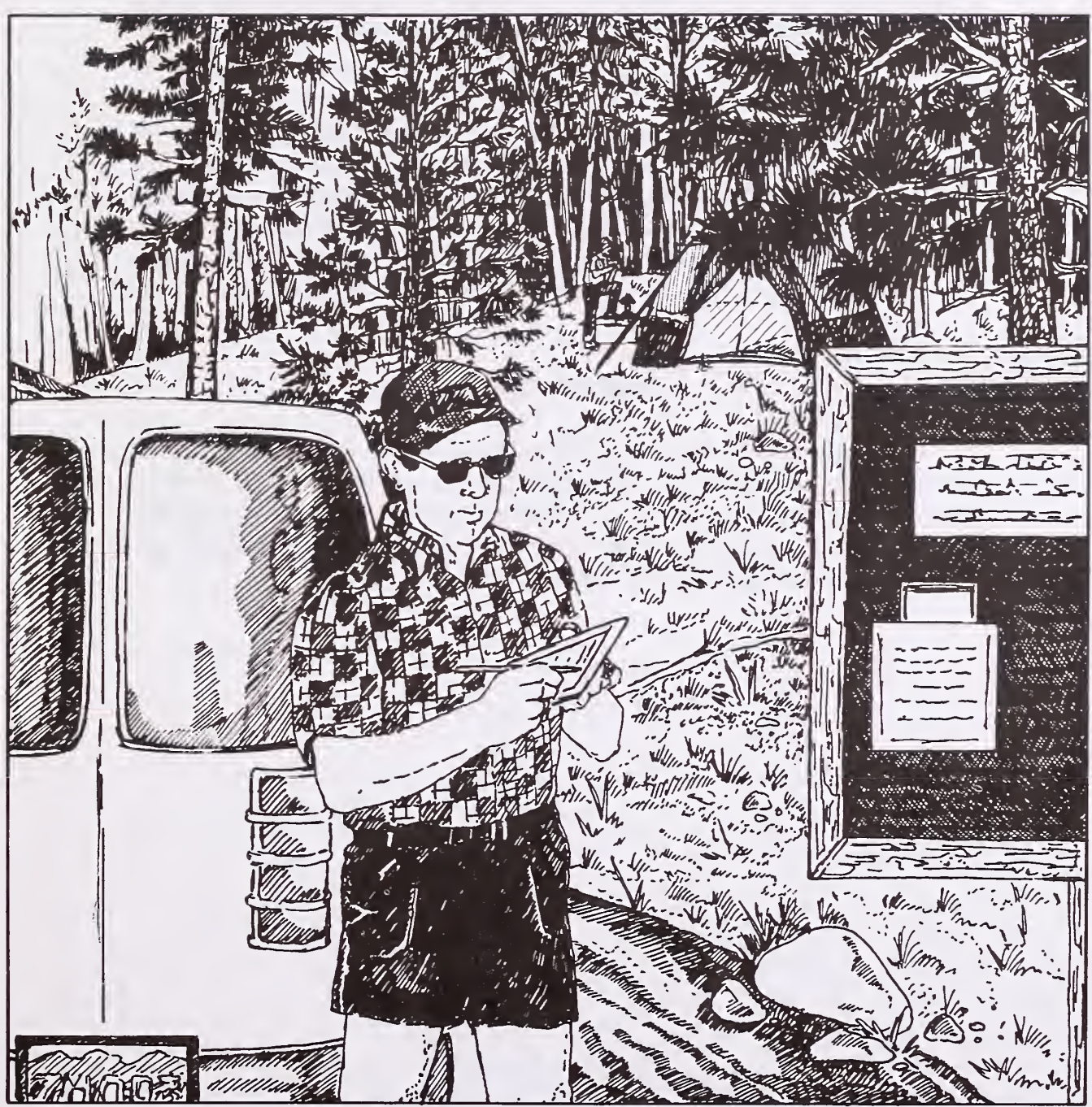
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Abstract

Registration fee envelopes were collected from visitors to 10 national forest campgrounds in Arizona and visitors were interviewed on-site. The information on the envelopes was used as the basis for specifying travel cost models and estimating consumer surplus for the sites. A sensitivity analysis of some of the assumptions of the travel cost method, facilitated by the interview information, allowed an assessment of the utility of fee envelope data for estimating the economic value of developed recreation sites. With careful analyses, fee envelopes successfully provided the basic data needed for the travel cost method, although the resulting estimates of total economic value are over-estimates to the extent that multiple-destination trips are unavoidably treated as single destination trips. Suggestions are made for minimizing such inaccuracies.

Acknowledgements

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Economic Value of Campground Visits in Arizona

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Contents

Introduction	1
The Travel Cost Method	1
Methods	3
Study Sites	3
The Survey	3
Visitor Origin Zones	4
Regression Models	6
Consumer Surplus	8
Results and Discussion	8
Visitation	8
Demand Functions	11
Estimates of Consumer Surplus	15
Multiple Destination Trips	17
Other Problems With Incomplete Data	19
An Application of the Results	20
Conclusions	21
Literature Cited	21

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Introduction

Providing recreation opportunities on national forest land has long been accepted as an appropriate public sector endeavor. Therefore it remains worthwhile, and politically important, to ascertain the economic benefits of spending tax dollars for these opportunities. Information on economic benefits can indicate whether certain recreation services are more valuable than other forest goods and services that could be provided on the same land area, and can help guide decisions on the relative amounts of various recreation services to provide. Such information can also be used as a partial basis for setting user fees.

The travel cost method (TCM) has been developed and refined to estimate the economic value people place on recreation sites. The TCM values a site by observing how much people are willing to pay to visit a site. The method is based on the reasonable assumption that people will make repeated trips to a site until the last trip is barely worth what they have to pay to get there. TCM analyses have been conducted in a variety of outdoor recreation situations for more than 20 years (Clawson and Knetsch 1966, Dwyer et al. 1977, Sorget al. 1984, Walsh et al. 1989).

The data for applying TCM are usually obtained by interviewing a sample of actual or potential visitors to the site. Interview data are expensive to gather. An on-site sample is typically less expensive than a reliable household survey of visitor origins, but even an on-site sample is usually restricted (because of cost) to a relatively small sample. The effort necessary to obtain an unbiased sample of on-site visitors requires special training of interviewers, careful construction of a survey instrument, and the logistics of appropriately timed visitor contacts. Because the sampling requirements of TCM are complex and the data are generally expensive to obtain, it would be useful to find an efficient, and yet effective, way to apply TCM for general public land recreation planning.

This paper investigates one approach to an efficient application of TCM to value use at developed public recreation sites. Users at nearly all developed national forest campgrounds are required to pay by inserting the posted fee in an envelope, upon the front of which they record responses to a few questions. One standard version of this envelope (the green-colored version) asks for home zip code, which greatly facilitates use of TCM. We arranged for this version to be used during the summer of 1985 at 10 forest campgrounds in Arizona.

The envelopes were collected in conjunction with a related study in the 10 campgrounds that required on-site interviews with a sample of the campers (Brown et al.

1990). The more detailed interview-data helped us investigate the utility of fee envelope data in travel cost analyses of the economic value of recreation sites. We approached this by specifying travel cost models from envelope data and then evaluating the sensitivity of our results to different assumptions.

Like most western states, Arizona offers less than ideal conditions for applying TCM because the state's population is sparse and very unevenly distributed. Arizona's approximately 3 million residents are spread over about 114,000 square miles. About two-thirds of the state's residents live in the greater Phoenix and Tucson metropolitan areas. We address some of the problems this raises for travel cost analyses.

This report is useful to those interested in the methodological problems of using a readily available data source to specify travel cost models and estimate economic value. Those who want to learn about visitation to and the value of Arizona developed campgrounds will also benefit from this report.

The Travel Cost Method

Using TCM to estimate a site's economic value involves two steps. First, a demand function is specified for the site, expressing visits to the site over some time period as a function of the cost of visiting the site and other relevant variables. Second, the mathematical integration of the demand function is used to calculate users' additional willingness to pay (their "consumer surplus") to visit the site (Clawson and Knetsch 1966).

There are two basic approaches to travel cost analysis: zonal and disaggregate (Fletcher et al. 1990 provide a recent review). Clawson and Knetsch (1966) initially proposed an aggregate, or zonal TCM, approach. This approach defines zones at varying distances from the recreation site. All visitors from within a zone are assumed to incur the same travel costs to reach the recreation site and to share the same socioeconomic characteristics. The nature of the drop in visits per capita from these zones as costs of travel to the site increase is used to derive the demand function for the site.

The success of the zonal approach depends on how the zones are defined. The assumption of homogeneity of travel cost and other characteristics can become heroic, particularly in regions where population is unevenly distributed across the landscape and road availability and quality varies substantially in different directions from the site. Suppose that concentric zones at 20-mile intervals of

increasing distance were defined around a campground. Visitors from each zone would be assigned the average zonal value for distance traveled, annual income, average age and education, etc. Visitors from small towns and large cities within a zone would be grouped together, and visitors who traveled on many different classes of roads might be grouped. Further, visitors who actually must travel, say, 21 miles to the campground would be assumed to pay the same travel costs and spend the same amount of time traveling as visitors who actually must travel 40 miles to the campground. While zones need not simply be defined as concentric bands out from the site, the averaging required no matter how the zones are defined always raises difficulties.

To overcome these averaging effects, many analysts (e.g., Gum and Martin 1975, Brown and Nawas 1973, Brown et al. 1983, Loomis 1982, Richards and King 1982, Richards and Wood 1985) have used a disaggregate, or individual, approach wherein the individual visitor household becomes the unit of analysis and the measure of use becomes visits per household. With this formulation, household-specific distinctions in socioeconomic characteristics and travel costs are maintained. A related advantage of the disaggregate approach is that the household's money cost and its time cost (perhaps as hours traveled) of travel can be separately and accurately represented in the analysis (McConnell and Strand 1981, Wilman 1980, Richards and Wood 1985).³

Hellerstein (1991), on the other hand, while acknowledging the problem of aggregation bias in zonal models, points out the difficulty (and expense) of avoiding sampling bias when using disaggregated survey data. To obtain valid statistical information on individuals for use in estimating demand, interviews with actual visitors to recreation sites are typically used. Interviewing only participants provides truncated (nonzero) data and may cause frequent visitors to more likely be sampled. Household surveys that include nonparticipants is one approach to dealing with the problem, but the surveys are very expensive.

In some situations, practitioners have the option of organizing their data to apply either the zonal or disaggregate approach, but other situations do not offer such flexibility. In fact, it is not uncommon that relatively few visits per season are made by individual households or persons to wildland recreation sites, even though total visitation is often quite large for a given site. Visitation rates are a function of the long distances from people's homes to the sites, of the availability of substitutes, and of people's wildland recreational behavior patterns. In many parts of the United States, urban residents travel long distances to reach forest camping opportunities. In Arizona, for example, opportunities for high-elevation forest camping

³ In the zonal approach, average travel time is a direct function of average distance traveled; including time as an independent variable may cause multicollinearity in the statistical estimation of demand between the travel time and money cost terms. The value of travel time needs to be expressed within the money cost term.

experiences are often more than 100 miles from the major population centers, which are located in warmer areas at lower elevations. Because of this, the number of visits per year made by any given household tends to be low. Although the principal economic decision-making unit is the individual or the household, and the number of visits per household or person is the most appropriate unit of analysis, the common rate of participation at the Arizona campgrounds we studied (one or two visits per year) precluded adequate TCM analyses for household units. Thus, we used a zonal TCM.

In order to correctly specify the demand curve in a TCM analysis, all of the relevant determinants of demand for the site must be included (such as visitors' income, age and/or education, preferences for recreation sites, and the availability of substitute sites), and the users' costs must be accurately specified (Rosenthal et al. 1984). In a zonal model, the zones must be delineated so that there is sufficient variation across zones in demand determinants and costs to allow reliable statistical estimation of demand (the zones must capture areas of relatively homogeneous characteristics). At the same time, the zones should be large enough in population to avoid sampling problems. The distribution of the Arizona user population creates significant, but not unique, challenges in this regard. There is no simple formula or rule of thumb for delineating zones; rather, as demonstrated in this report, the trade-offs required in delineating origin zones require considerable judgment.

To correctly specify the price variables in the model, the costs of recreating at a particular site must be appropriately measured by accurately reflecting the monetary and time costs of visiting the site but excluding costs incurred for related experiences or benefits beyond the site in question. A problem common to both the zonal and the disaggregate approaches occurs when users visit more than one site on a single trip; the allocation of joint costs (e.g., for travel) to individual sites is somewhat arbitrary. Haspel and Johnson (1982) have examined the consequences of such trips on TCM values when multiple sites include major destinations such as national parks (their results may not apply to trips involving less prominent sites). Regional travel cost models (Burt and Brewer 1971, Cesario and Knetsch 1976, Sorg et al. 1984, Loomis et al. 1986) could potentially account for the total benefits accrued in multiple destination trips, if the defined region were to include all relevant trip destinations. The allocation of benefits to each site, however, remains problematic.

Another approach to the problem of determining multiple destination trips with limited data in TCM studies has been described by Smith and Kopp (1980). They hypothesize that with increases in distance from a site, the behavior of visitors will become inconsistent with the assumptions of TCM; e.g., visitors will be more likely to engage in multiple destination trips. They recommend examining the distance-ordered residuals of the estimated

demand models, looking for progressively more pronounced nonrandom fluctuations. Using a statistically determined confidence interval for the residuals, a distance limit is reached when the cumulative sum (over distance) of the squared residuals exceeds the confidence interval. Smith and Kopp recommend restricting TCM value estimates to data points that fall within the limit. For example, for visitation data to a California wilderness area, the authors determined a distance limit of 672 miles from the site, beyond which the residuals statistic falls outside a 90% confidence interval. Their findings, of course, apply to a different recreation experience than the ones described in this paper.

Envelope data do not easily permit an assessment of multiple destination trips since they do not include the critical information about which parties visited which other sites on a given trip. We estimated site-specific travel cost models based on the envelope data but examined the interview data to assess the potential errors of this simplified approach.

Methods

Study Sites

The 10 national forest campgrounds where we gathered our data were selected to represent developed public recreational opportunities in the ponderosa pine forest type in Arizona. Like most of the state's forest lands, these ponderosa pine areas are publicly owned. The level of development, quality of facilities, and variety of opportunities were relatively homogeneous across the campgrounds, but the forest stands varied in age class distributions, densities, and associated plant species.⁴ Campground elevations ranged from 5,500 feet to 7,500 feet. The campgrounds and their locations are shown in figure 1 and table 1.

⁴ One campground was in a predominantly pinon-juniper association (within the ponderosa pine type).

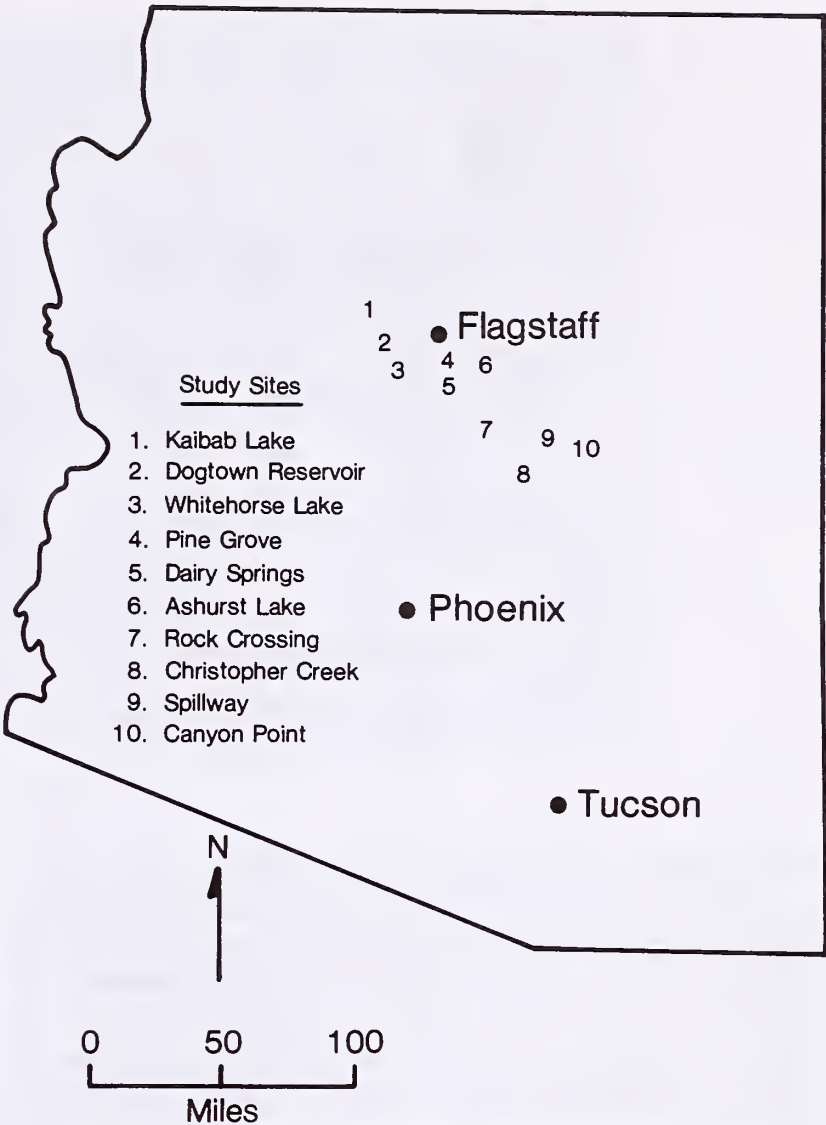


Figure 1.—Study sites and major urban origins in Arizona.

The Survey


The primary season of use at the campgrounds was from the Memorial Day holiday weekend through the Labor Day weekend. Registration (fee) envelopes (fig. 2) collected by the Forest Service provided 1985 season-long estimates of total visits to each of the campgrounds as well as additional information on the geographical origins of the campers.

Table 1.—Campground locations and daily entry fees.

Campground	National Forest	Miles and direction from reference town		Fee
Ashurst Lake	Coconino	22	SE Flagstaff	\$3.00
Canyon Point	Apache-Sitgreaves	32	NE Payson	5.00 ^a
Christopher Creek	Tonto	16	NE Payson	5.00
Dairy Springs	Coconino	26	SE Flagstaff	3.00
Dogtown Reservoir	Kaibab	8	S Williams	6.00
Kaibab Lake	Kaibab	4	NE Williams	6.00
Pine Grove	Coconino	19	SE Flagstaff	5.00
Rock Crossing	Coconino	45	N Payson	4.00
Spillway	Apache-Sitgreaves	31	NE Payson	7.00
Whitehorse Lake	Kaibab	19	S Williams	6.00

^a Two fees are charged at this campground, \$4.00 and \$6.00. The fees were averaged for this analysis.

USDA—Forest Service



TO VALIDATE COMPLETE THE FOLLOWING

(Make checks payable to USDA—Forest Service)

Complete This Block ONLY ONCE During Your Stay		
1. First Day Arrival Time Nearest Hr. <input type="text"/> AM/PM <input type="text"/> (8-9) (10)		2. No. People in Party <input type="text"/> (11-12)
3. Home Zip Code (First 5 digits) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (13-17)	4. Expected Departure Date Mo. <input type="text"/> Day <input type="text"/> Nearest Hr. <input type="text"/> AM/PM <input type="text"/> (18-19) (20-21) (22)	
1. Amount Enclosed <input type="text"/>	2. No. of Days Paid <input type="text"/>	3. Date Permit Purchased Mo. <input type="text"/> Day <input type="text"/> Yr. <input type="text"/> (23-28)
4. Car License <input type="text"/>	5. State <input type="text"/>	6. Selected Camp Unit No. <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (29-34)
7. Golden Age or Golden Access Passport No. (if applicable) <input type="text"/>		

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Figure 2.—Fee envelope.

Because the fee payment is generally enforced, the compliance rate on the use of envelopes is high, providing close to a 100% sample of visitation to the site. Reporting of vehicle license plate numbers is quite reliable because the license plate number is used to identify the payor. Other information requested on the envelopes, such as home zip code, length of stay, and number of people in the party, may be somewhat less reliable. As seen in figure 2, no information is requested regarding visits to other sites while on the same trip.

In addition to the envelope information, interviews were conducted over a six-week period in July and August of 1985. Weekdays and weekend days were sampled equally, and on any sample day all visitors to a sampled campground were asked to participate in the survey. The on-site survey is described more fully in Richards et al. (1990).

Visitor Origin Zones

In specifying origin zones for TCM, two sometimes divergent criteria should be employed: (1) each visitor in a given origin zone should face about the same travel distance to the recreation site; and (2) the socioeconomic and demographic characteristics of visitors within a zone should be homogeneous. Further, origin zones should be specified to reflect the true probability of visitation and not just observed (nonzero) visitation data. If origins with a visitation probability greater than zero are excluded when no visits are sampled during the study, then demand for the site will be estimated on truncated (nonzero visit) data and benefits may be overestimated (Hellerstein 1991). Also, if the probability of observing visitors to the site from an origin is affected simply by the size of the origin population, all

else equal, then demand estimates may be inflated (Brown et al. 1983).

Unequal populations across origin zones can be standardized by examining visits per capita, but attempting to include all origins with a probability of producing visitors to the site, irrespective of actual visitation, raises practical difficulties. It means (1) that the market boundary of the study should include all origins with a probability of generating visits and (2) that all geographic areas within the market boundary of the study, even those that produced no visits to the study site during the sample period, should be considered as origin zones or parts of origin zones. Given the geographic and demographic characteristics of western states, this may present a major difficulty in applying TCM to public recreation sites. The market area for analysis may contain too many origin zones with zero visits to statistically estimate travel cost demand functions, and the probability of including multiple destination visits increases with distance from origins to sites.

Since there is no theoretical limit on either the distance or number of origins or zones that may have potential relevance for a TCM study, a somewhat arbitrary market boundary must be defined. We selected the state boundary to define the geographic limits of our market area. The envelopes we collected reveal that nearly 90% of the 1985 visitors came from within Arizona. Also, due to the relatively central location of the study sites within the state, the state boundary serves as a market boundary with a reasonably constant distance criterion, making it unlikely that we would exclude out-of-state origins closer to the study sites (with a higher probability of supplying visits) than some in-state origins. The relatively few non-Arizona origins that supplied visitors to the study sites were widely scattered at distances that "leap-frogged" very large areas.

Such conditions greatly compound the statistical problem of zero-visits in the data base and increase the likelihood of multiple destination visits.

Within the state boundary, we specified the market area as the set of origins that were likely to produce visits. All other possible origins within Arizona were considered unlikely to provide visitors to the study sites. We defined the likely set of potential visitor origins for the campgrounds as those locations represented by the Arizona zip codes found on the fee envelopes collected at all 10 of the campgrounds. Because envelopes were collected from essentially all 1985 visitors to the campgrounds, the resulting origins represent the full population of 1985 visitors. They may, however, fail to capture all potential visitors.

Zip code areas were grouped if they bordered each other or were close together and shared the same logical travel routes to the overall campground study area. Then adjacent or nearby areas were added to these zip code groups if these additional areas were logically part of the same potential user population. Using this procedure, a total of 34 origin zones were delineated. Of course, given this procedure, there were visitors in 1985 from each of these zones to at least one of the 10 campgrounds. However, individual campgrounds did not necessarily receive visitors from each origin zone. In the envelope data, individual campgrounds received visits from a minimum of 23 to a maximum of 32 zones; and interviews were obtained from visitors from a minimum of 10 to a maximum of 19 zones.

Phoenix, Arizona's largest city, was divided to form two zones. Because the campground study area is generally north of Phoenix, the city was divided into a North Phoenix zone and a South Phoenix zone. Table 2 shows all the origin zones denoted by their principal cities and towns.

The total population of the 34 origin zones was 2,461,000—about 80% of Arizona's estimated 1985 population.⁵ Of the remaining 20% of the population not accounted for by the market area defined for this study, 5%, or about 140,000 people, live in mostly small communities around the state for which no recreation visits to any of the study campgrounds were reported. The remainder of Arizona's citizens, nearly 15%, are apparently located in rural, nonmunicipal locales of the state that were not represented among the zip codes we found on the envelopes.

The 34 origin zones defined for this study were intended to represent both actual visitors to the study campgrounds and those with a reasonable probability of participating. Nevertheless, defining zones for all in-state areas that contributed visitors, even those contributing very few visitors, sometimes creates zones with anomalously high per capita participation rates when visits to a campground were made from small, geographically isolated communities. Dividing these actual visits by their small population base gave unrealistically high projected visits per

⁵ The origin zones are located in 13 of the state's 15 counties. The two counties not included are the most rural, containing 3% of the state's land area and 1% of its population.

Table 2.—Arizona cities by origin zone.

Origin zone	City
1	North Phoenix
2	South Phoenix
3	Tucson, Green Valley
4	Mesa, Gilbert, Chandler, Apache Junction
5	Tempe
6	Scottsdale, Fountain Hills
7	Casa Grande, Florence, Coolidge
8	Marana
9	Kearny, Superior, Globe
10	Glendale, Sun City, Sun City West, Peoria, El Mirage
11	Black Canyon City
12	Buckeye, Goodyear, Avondale, Tolleson, Litchfield Park
13	Yuma, Wellton
14	Parker
15	Wickenburg, Yarnell
16	Payson, Pine
17	Sierra Vista, Benson, Sonoita
18	Flagstaff
19	Grand Canyon
20	Prescott, Prescott Valley, Chino Valley, Dewey, Mayer, Paulden
21	Camp Verde, Clarkdale, Cottonwood, Rimrock, Cornville
22	Sedona, West Sedona
23	Kingman, Bull Head City, Mohave Valley, Riviera, Dolan Springs, Fort Mohave, Hualapai
24	Lake Havasu City
25	Cave Creek, Carefree
26	Ehrenburg
27	Ash Fork, Seligman
28	Munds Park
29	Williams
30	Winslow
31	Morenci, Safford, Bylas, Pima, Thatcher
32	Showlow, Lakeside, Whiteriver, Snowflake, Pinetop, St. Johns, Eager, Alpine, Springerville
33	Chinle, Dennehotso, Redrock, Sanders, Houk, Second Mesa, Ft. Defiance, Ganado
34	Gila Bend

capita at a given cost of travel relative to the larger population zones.

One way to deal with this problem is to combine this type of zone with more "well-behaved" zones, summing their populations and averaging their demographic characteristics. We followed this procedure in a few cases. However, in many other cases, given the geographic areas involved, and the scattered and diverse populations, the desired homogeneity of visitor characteristics within origin zones becomes lost with such combining and averaging.

Another way to treat the problem is to drop such zones from the analysis, either by initially establishing an arbitrary visitation or population minimum below which visitor origins would not be included, or by including the zones initially in the demand analysis step, identifying the problem zones as "outliers," and removing them at that point. The latter treatment is somewhat conservative in that some of the questionable zones may or may not emerge

as “outliers” in the demand analysis depending on the relative structure of all other zones (Richards et al. 1990).

We used this latter approach. “Outlier” origin zones were identified if plots of visits per capita against costs of travel indicated unusually high visits at high travel cost. The scatter of points (coordinates) in each plot normally clustered along a line curving from the upper left of the plot to the lower right. Points located in the upper right region of a plot, and distinctly removed from the cluster, were considered outliers. Such points, the anomalous result of computing visits per capita with certain origin zones, violate the “law of demand.”

Our procedure in defining the market area is subjective and judgmental. We attempted to pursue a logical course that would minimize bias in our estimates of benefits. However, market area definition, including “outlier” elimination, is always problematic, potentially allowing the investigator’s, or the theory’s, biases to affect the results. To examine the implications of decisions about “zero-visit” zones and “outlier” zones, we developed demand functions and estimates of consumer surplus for four combinations of visitation data: including all “zero-visit” zones (within the defined market area) and “outlier” zones, excluding both of these types of zones, and the other two logical combinations, as seen in figure 3. The results permit us to better examine the consequences of our procedure for defining the market.

Regression Models

With stepwise multiple regression analysis, zonal travel cost models were developed for each campground. The case for analysis was the zone. Models were attempted for each campground using four sets of visitation data, depending on whether only origin zones showing envelope use at a campground were included or whether all 34 origin

		Zero-visit origin zones	
		included	excluded
Outlier regions zones	included	1	2
	excluded	3	4

Figure 3.—Alternative data sets for estimation of demand and value.

zones (even zero-visit zones) were included for each campground, and depending on whether outlier zones were included. The dependent variable, trips per capita per year, was regressed against the per-person price of a trip to the campground from the origin zone, and other independent variables representing substitute campgrounds and the socio-demographic characteristics of the origin zone.⁶ In the stepwise regression approach, the minimum significance level for variables to enter the model was $p \leq 0.10$, and to leave was $p \geq 0.20$. The socio-demographic variables included zone population, the average number of years of education completed by individuals 25 years and older for the county in which the origin zone was located, and the average per capita income and average age of residents for the county in which the origin zone was located. Values for these variables are listed in table 3.

Total visits per origin zone to each campground were based on envelope data, where one vehicle was assumed to equal one visit. The population of each origin was determined by summing the appropriate city (or other statistical jurisdiction) populations used to define the origin. Total visits per origin zone were then divided by population to get visits per capita.

Distances were calculated from the approximate center of each origin to each campground. These data were used to create the price variable (cost of travel) for each campground model, as shown by the following equation (based on a similar equation presented in Rosenthal et al. 1986):

$$P_{ij} = \frac{D_{ij} * CM}{V_j} + \frac{D_{ij} * CO_j}{S} + \frac{F_j}{V_j} \quad (1)$$

where

P_{ij} = round trip cost of travel from origin i to campground j

D_{ij} = round trip distance in miles from origin i to campground j

CM = \$0.126, the estimated average cost per mile for all private passenger vehicles for 1984 (U.S. Department of Transportation 1984), inflated to 1985 using the Consumer Price Index

V_j = average number of persons per party at campground j

CO_j = cost of travel time equal to 50% of the annual hourly wage value of the average per capita income across origins of visitors to campground j

S = 50, the estimated average travel speed in miles per hour

F_j = 1985 entry fee for campground j .

For each model, variables representing substitute campgrounds were defined to be any and all P_{ij} not equal to the

⁶ Alternatively, the analysis could have been performed in terms of parties (which is synonymous to vehicles given the envelope data). In this case, party size could be included as an independent variable to test whether party size varies systematically with distance.

Table 3.—Socio-demographic characteristics by origin zone estimated for 1985.

Origin zone	County	Population	Education ^a	PCI ^b	Age ^c
1	Maricopa	440,820	12.7	14,000	29.4
2	Maricopa	440,820	12.7	14,000	29.4
3	Pima	392,681	12.7	12,283	29.1
4	Maricopa	330,156	12.7	14,000	29.4
5	Maricopa	132,942	12.7	14,000	29.4
6	Maricopa	108,447	12.7	14,000	29.4
7	Pinal	37,205	12.2	8,414	28.2
8	Pima	2,195	12.7	12,283	29.1
9	Gila	16,595	12.3	9,780	30.5
10	Maricopa	206,331	12.7	14,000	29.4
11	Yavapai	1,970	12.6	11,542	38.4
12	Maricopa	29,313	12.7	14,000	29.4
13	Yuma	56,856	12.3	8,987	27.4
14	La Paz	2,825	12.3	8,987	27.4
15	Maricopa	4,960	12.7	14,000	29.4
16	Gila	7,660	12.3	9,780	30.5
17	Cochise	30,620	12.5	9,542	28.2
18	Coconino	40,180	12.8	9,475	23.1
19	Coconino	1,375	12.8	9,475	23.1
20	Yavapai	36,870	12.6	11,542	38.4
21	Yavapai	15,200	12.6	11,542	38.4
22	Coconino	8,215	12.8	9,475	23.1
23	Mohave	30,020	12.5	9,838	37.0
24	Mohave	18,295	12.5	9,838	37.0
25	Maricopa	3,115	12.7	14,000	29.4
26	Yuma	300	12.3	8,987	27.4
27	Yavapai	610	12.6	11,542	38.4
28	Coconino	500	12.8	9,475	23.1
29	Coconino	2,360	12.8	9,475	23.1
30	Navajo	8,240	12.3	7,987	22.9
31	Graham	14,000	11.8	7,902	26.1
32	Navajo-Apache	26,152	11.1	7,365	22.0
33	Apache	10,717	9.8	6,691	21.0
34	Maricopa	1,999	12.7	14,000	29.4

^a Average education in years within the county. Source: U.S. Dept. of Commerce (1983).

^b Average 1985 per capita income in dollars. Source: Valley National Bank (1986).

^c Average age in years within the county. Source: U.S. Dept. of Commerce (1983).

price variable used in that model. That is, the effects of substitutes were estimated by entering as independent variables the cost of travel from each origin for the model campgrounds to every other campground.

An important consideration in building statistical models to estimate economic demand functions is the selection of functional form. Although multiple linear regression analysis assumes linearity and independence between variables, it is appropriate to independently transform the model variables to better represent the functional relationships in the data. Such transformations allow nonlinear associations between independent data coordinates to be treated linearly.

Data on visits per capita from each origin were plotted graphically against the cost of traveling from the origin to each of the 10 campgrounds. Each of these plots showed a nonlinear relationship between the dependent variable (visits per capita) and travel cost, the essential independent

variable in an economic demand function. A logarithmic transformation of either variable, or both, would represent the nonlinear relationship revealed in the data plots.

To help select which functional transformation to use with these data, preliminary regression analyses were made for each campground using a common set of non-price independent variables (such as age). Comparisons were made based on the adjusted R^2 and the statistical significance of the cost term for each model. In order to make meaningful comparisons between models with the logarithmic form of the dependent variable and those without, the dependent variables were standardized by their geometric means and the residual sums of squares for each were compared (Rosenthal et al. 1986). The semilog-dependent (logarithmic transformation of the dependent variable) form gave superior results for most campgrounds. The double log transformation was slightly superior, in terms of moderately higher R^2 values, for some camp-

grounds. Semilog-independent and quadratic forms were not successful; either the residual sum of squares was higher for these models, or no feasible model could be estimated. Other studies using TCM (Strong 1983, Ziemer et al. 1980, Kling 1989) have shown or argued that the semilog-dependent transformation is to be preferred for its tendency to moderate the heteroskedastic nature of the visits per capita variable (the error variance of the regression is not constant with changes in the dependent variable). However, Adamowicz et al. (1989) argue in favor of the double log form as providing greater stability in the welfare measure (consumer surplus), which can vary with functional form. In this study we wanted to observe the changes in welfare estimates that result from known or expected biases in the available data, so we were concerned primarily with stability in demand structure and only secondarily with the reliability of the resulting welfare estimates. Thus, the semilog-dependent functional form was used for the demand models estimated for this study.

Consumer Surplus

The net economic benefit of a social good or service is typically measured as consumer surplus, the consumer's willingness to pay for a good or service above what he or she actually pays. Consumer surplus is mathematically equivalent to the area under a demand curve and above the price (i.e., cost) of participation. These areas were estimated for each campground using a computer algorithm supplied by Arnold et al. (1991). Consumer surplus was estimated several times for each campground, each time under different modeling assumptions (including different sets of zones). The different estimates were compared to examine the impact (bias) of the assumptions, as well as the limitations of using zonal TCM to estimate the economic value of forest campgrounds.

Results and Discussion

Visitation

More than 17,600 fee envelopes were collected at the 10 campgrounds in 1985. Because visitors on multiday stays have the option of paying (and therefore filling in an envelope) on a daily or multiday basis, not every envelope represented a unique visit. Thus, it was sometimes necessary to combine envelopes into single visits, which was only possible for those envelopes with the car license plate number, the purchase date, and the number of days paid filled in. The 16,519 of the 17,669 envelopes (93%) that had these items filled in were selected for further analyses (table 4). Envelopes were then combined into a single visit if, for a given license plate number, the date indicated by the purchase date plus number of days paid was only one day short of the next purchase date. If there was a break of

at least one day (one day not paid for), the subsequent envelope was considered a new visit. Accounting for multiple envelopes per visit in this fashion indicates that there were 12,108 visits reported by 16,519 envelopes (not counting the 1,150 envelopes missing the relevant information). Mean length of stay across all campgrounds was about 2.4 days (table 4).

Forty-four percent of the campground visits lasted only 1 day (including an overnight stay), while an additional 28% were for 2 days (table 5). Only 10% stayed for 5 or more days. The visits were about equally spread over the months of June, July, and August (table 6). Some campgrounds were not opened until June; visitation in May in table 6 was for the Memorial Day weekend. All campgrounds were closed by mid-September.

Nearly 90% of the visitors came from within Arizona (table 7). California was the only other significant state of origin, contributing 6% of the visits; with Texas, Nevada, and New Mexico each contributing about 1% of the visits. All other states and foreign countries contributed fewer than 50 visits each, and in total contributed 6% of the visits.

Ninety-three percent of visitor vehicles (denoted by license plate number) were found to make only one visit to a given campground in 1985 (table 8). Five percent made 2 visits and 1% made 3 visits. Repeat visits were more common at Canyon Point, Dairy Springs, and Pine Grove campgrounds.

A similar conclusion about repeat visits was reached upon investigation of the 972 usable on-site household interviews (table 4). The mean number of trips per household per year across the 10 campgrounds ranged from 1 to 1.8, with an overall mean of less than 1.5 trips. This lack of variation in number of trips per household precluded estimating individual observation travel cost models.

To estimate demand functions based on visitation from each of the visitor origin zones defined for this study, we reduced the visitation data reported in table 4 to that based only on envelopes with valid Arizona zip codes. Of the 14,684 envelopes from Arizona visitors, only 11,655 (79%) contained valid zip codes, and only 10,550 (72%) contained both zip code and the 3 items needed to convert from envelopes to visits (license plate number, purchase date, and number days paid) (table 9). Using this procedure, these completed envelopes indicate a total of 9,056 household visits (table 9).

Because this estimate of visits (9,056) was based only on completed envelopes, it is an underestimate. It did not seem appropriate to exclude actual visits simply because envelopes were not completely filled in. Of particular importance for travel cost models are the origin zone-specific estimates of visits (because it is the relationship of visits to zone characteristics, across zones, that yields the demand function). Indeed, if the proportion of incomplete envelopes varied by origin zone, exclusion of these envelopes could produce biased demand equations. Therefore, we adjusted the visit estimates, on a zone-by-zone basis,

Table 4.—Number of envelopes, household visits, on-site interviews, and mean length of stay by campground.

Campground	Number of Envelopes		Household visits	On-site interviews	Mean Length of stay (days)
	Total	Completed ^a			
Ashurst Lake	1,085	1,011	803	76	2.09
Canyon Point	2,930	2,716	1,912	129	2.66
Christopher Creek	1,960	1,880	1,405	143	2.30
Dairy Springs	970	880	649	68	2.45
Dogtown Reservoir	1,422	1,368	1,124	45	2.07
Kaibab Lake	2,271	2,020	1,425	77	2.07
Pine Grove	1,814	1,730	1,007	65	3.39
Rock Crossing	793	753	637	61	1.93
Spillway	1,721	1,616	1,210	117	2.54
Whitehorse Lake	2,703	2,545	1,936	191	2.42
Total	17,669	16,519	12,108	972	

^a The following items were filled in: license plate number, purchase date, and number of days paid.

Table 5.—Number of household visits by length of stay (days) per visit for each campground.

Days	Ashurst Lake	Canyon Point	Christopher Creek	Dairy Springs	Dogtown Reservoir	Kaibab Lake	Pine Grove	Rock Crossing	Spillway	Whitehorse Lake	Total	Percent
1	418	761	648	303	561	766	315	286	479	728	5,265	43.8
2	228	478	371	175	327	389	284	226	329	625	3,432	28.3
3	59	260	149	58	113	89	81	75	181	271	1,336	11.1
4	38	156	106	37	44	89	127	29	86	139	851	6.8
5+	60	257	131	76	79	92	200	21	135	173	1,224	9.9
Total	803	1,912	1,405	649	1,124	1,425	1,007	637	1,210	1,936	12,108	99.9

Table 6.—Number of household visits by month of purchase for each campground.

Months	Ashurst Lake	Canyon Point	Christopher Creek	Dairy Springs	Dogtown Reservoir	Kaibab Lake	Pine Grove	Rock Crossing	Spillway	Whitehorse Lake	Total	Percent
May	20	224	10	7	15	38	21		159		494	5.0
June	342	572	379	250	239	542	352	150	322	606	3,754	30.3
July	260	528	413	188	311	485	282	239	308	613	3,627	29.5
August	155	447	404	188	506	315	292	241	303	564	3,415	27.3
Sept.	26	141	199	16	53	45	60	7	118	153	818	7.9
Total	803	1,912	1,405	649	1,124	1,425	1,007	637	1,210	1,936	12,108	100.0

Table 7.—Number of household visits by state of origin for each campground.

State	Ashurst Lake	Canyon Point	Christopher Creek	Dairy Springs	Dogtown Reservoir	Kaibab Lake	Pine Grove	Rock Crossing	Spillway	Whitehorse Lake	Total	Percent
AZ	694	1,671	1,300	566	908	713	853	598	1,128	1,761	10,192	85.8
CA	37	50	28	23	88	300	52	10	16	90	694	5.8
TX	3	21	14	5	16	36	14	6	4	8	127	1.1
NM	8	11	6	7	7	31	11	1	7	5	94	.8
NV	5	8	1	9	11	27	10	1	2	14	88	.7
All Other	39	76	37	28	80	296	49	17	30	40	692	5.8
Totals	786	1,837	1,386	638	1,110	1,403	989	633	1,187	1,198	11,887 ^a	100.0

^a The total is less than 12,108 because each license number was counted only once.

Table 8.—Number of visits per license number for each campground.

Visits	Ashurst Lake	Canyon Point	Christopher Creek	Dairy Springs	Dogtown Reservoir	Kaibab Lake	Pine Grove	Rock Crossing	Spillway	Whitehorse Lake	Total	Percent
1	739	1,492	1,195	540	939	1,320	822	592	1,074	1,688	10,401	93.4
2	27	148	67	41	72	48	54	21	41	91	610	5.1
3	2	22	15	5	11	3	16	1	11	18	104	1.1
4	1	10	3	3	2	0	3	0	4	3	29	.3
5+	0	3	3	0	0	0	3	0	1	0	10	.1
Total	769	1,675	1,283	589	1,024	1,371	898	614	1,131	1,800	11,154 ^a	100.0

^a The total is less than 12,108 because each license number was counted only once.

Table 9.—Number of envelopes, household visits, and adjusted visits for Arizona visitors only.

Campground	Number of Envelopes			Household visits ^b	Adjusted visits ^c
	Total	With zip code	Completed With zip code ^a		
Ashurst Lake	936	838	750	655	733
Canyon Point	2,528	1,973	1,732	1,530	1,744
Christopher Creek	1,814	1,424	1,325	1,154	1,240
Dairy Springs	836	668	590	507	574
Dogtown Reservoir	1,139	925	883	819	858
Kaibab Lake	1,136	964	829	631	735
Pine Grove	1,539	1,097	1,012	732	796
Rock Crossing	745	649	603	555	597
Spillway	1,588	1,152	1,049	916	1,006
Whitehorse Lake	2,423	1,965	1,777	1,557	1,723
Total	14,684	11,655	10,550	9,056	10,006

^a "Completed" indicates that the following items were filled in: license plate number, purchase date, and number of days paid.

^b Visits based on "completed envelopes" with zip codes.

^c Visits (column 5) times the ratio of number of envelopes with zip codes (summarized in column 3) to the number of completed envelopes with zip codes (summarized in column 4), completed by origin zone for each campground.

based on the ratio of number of envelopes with at least the zip code filled in to the number of envelopes with all four items filled in.⁷ As we summed across origin zones, this adjustment procedure yielded a total of 10,006 household visits, as listed in column 6 of table 9.

The adjusted household visits of table 9 were expanded by the average party size per campground (the average party size was assumed to be constant across origin zones) to yield an estimate of person visits. The total number of adjusted person visits by origin zone for each campground are shown in table 10. These expanded visitation data are the appropriate basis for computing visits per capita for use in the regression models of economic demand.

⁷ It would perhaps have been more correct to base the adjustment on the ratio of the total number of envelopes to the number of envelopes with all four items filled in, but this adjustment could obviously not be done on a zone-by-zone basis, as a zip code is needed to specify the zone. Such an adjustment could only be applied uniformly across all zones, which would have no effect on the resultant demand model (although it would affect estimates of consumer surplus).

Demand Functions

The zone-specific visitation data in table 10 were converted to visits per capita and regressed on the cost of travel and other socio-demographic variables to estimate demand equations for each campground. The travel cost variable for each origin zone and campground was developed as in Equation 1 using the data shown in table 11.

Stepwise regression analysis was applied to the four combinations of visitation data (fig. 3), differing in the treatment of "zero-visit" and "outlier" origin zones. The regression statistics in table 12 were developed from the most restrictive data set. This set included only those origin zones that produced visits for a given campground (i.e., zero-visit origin zones were excluded), and that were not considered "outliers." To show the effect of removing the outliers, another set of regression equations was attempted on these data sets, but with the outliers included. These results are displayed in table 13.

Table 10.—Number of adjusted person-visits by origin zone across campgrounds.

Zone	Ashurst Lake	Canyon Point	Christopher Creek	Dairy Springs	Dogtown Reservoir	Kaibab Lake	Pine Grove	Rock Crossing	Spillway	Whitehorse Lake	Total
1	345	847	797	352	336	233	450	330	576	848	5,114
2	479	877	1,209	369	351	299	586	425	971	1,099	6,665
3	140	182	112	134	49	74	174	68	143	74	1,150
4	175	1,558	1,346	252	171	134	335	295	869	388	5,523
5	73	476	425	135	55	28	95	130	233	159	1,809
6	68	595	390	104	55	39	103	115	270	124	1,863
7	32	19	103	46	31	25	26	22	58	47	409
8	0	3	0	32	12	9	3	0	0	3	62
9	7	22	12	7	3	0	10	14	54	10	139
10	234	458	585	221	258	214	356	257	398	827	3,808
11	23	3	0	0	3	12	13	4	0	40	98
12	61	42	166	39	43	36	36	36	97	119	675
13	13	13	17	14	43	98	13	14	20	95	340
14	3	3	0	0	9	5	10	4	8	10	52
15	7	50	9	18	37	69	26	33	4	51	304
16	52	74	35	7	3	6	10	39	65	17	308
17	16	15	4	16	15	27	20	14	8	10	145
18	285	16	30	92	178	151	45	50	8	415	1,270
19	7	0	0	14	9	27	3	0	0	44	104
20	92	111	73	36	414	234	41	135	27	641	1,804
21	124	45	17	28	58	55	75	47	46	231	726
22	36	78	13	36	9	20	48	11	6	34	291
23	61	7	0	28	336	286	41	4	4	291	1,058
24	19	16	0	4	37	79	29	11	4	164	363
25	3	42	9	18	10	0	3	33	8	17	143
26	0	7	0	5	0	12	0	4	4	10	42
27	0	0	0	4	37	0	0	0	0	17	58
28	0	7	0	0	6	3	0	0	0	0	16
29	3	0	0	0	43	15	0	4	0	34	99
30	7	22	0	16	3	3	0	29	22	14	116
31	0	3	4	0	6	0	3	4	0	7	27
32	3	39	4	7	6	9	18	4	4	21	115
33	3	15	17	4	0	3	7	15	8	0	72
34	3	3	4	4	6	0	9	11	0	14	54
Total	2,374	5,649	5,383	2,041	2,634	2,205	2,586	2,162	3,913	5,875	34,822

Table 11.—Data for conversion of distance to travel cost in Equation 1, by campground.

Campground	Cost per mile (CM)	Cost of travel time (CO _t)	Campground entry fee (F _j)	Average party size (V _j)	Speed in miles per hour (S)
Ashurst Lake	\$.126	\$2.65	\$3.00	3.24	50
Canyon Point	\$.126	\$2.62	\$5.00	3.24	50
Christopher Creek	\$.126	\$2.75	\$5.00	4.34	50
Dairy Springs	\$.126	\$2.65	\$3.00	3.55	50
Dogtown Reservoir	\$.126	\$2.65	\$6.00	3.07	50
Kaibab Lake	\$.126	\$2.62	\$6.00	3.00	50
Pine Grove	\$.126	\$2.67	\$5.00	3.25	50
Rock Crossing	\$.126	\$2.66	\$4.00	3.61	50
Spillway	\$.126	\$2.65	\$7.00	3.89	50
Whitehorse Lake	\$.126	\$2.66	\$6.00	3.41	50

Table 12.—Regression statistics by campground using only origin zones with actual visits recorded by envelopes, outliers excluded.

Independent variable coefficients ^a								
Campground	Constant	Price	Income	Age	Substitutes ^b	n	Adj. R ²	F
Ashurst Lake	-7.302 (-8.396)*	-.051 (-5.466)*		.074 (2.535) ⁺		28	.54	16.79*
Canyon Point	-4.865 (-10.209)*	-.046 (-3.488)*				29	.29	12.17*
Christopher Creek	-5.200 (-9.883)*	-.054 (-2.889)*				23	.25	8.34*
Dairy Springs	-5.389 (-13.984)*	-.046 (-4.004)*				27	.37	16.03*
Dogtown Reservoir	-5.902 (-12.616)*	-.067 (-6.711)*			.057(CC) (4.452)*	32	.61	25.24*
Kaibab Lake	-6.434 (-14.192)*	-.057 (-5.446)*			.058(CC) (4.614)*	28	.57	18.55*
Pine Grove	-7.096 (-7.693)*	-.034 (-3.528)*		.051 (1.826) [#]		28	.35	8.34*
Rock Crossing	-5.678 (-15.783)*	-.046 (-4.134)*				26	.39	17.09*
Spillway	-5.283 (-10.549)*	-.048 (-3.400)*				25	.31	11.56*
Whitehorse Lake	-6.351 (-7.569)*	-.069 (-8.675)*		.066 (2.592) ⁺	.032(SP) (3.215)*	31	.75	30.52*

^at-statistics in parentheses, significance level: * = .01; + = .05; # = .10

^bSubstitute campground noted in parentheses: SP = Spillway; CC = Christopher Creek

For the regression models of tables 14 and 15, zero-visit origin zones were included in the analysis.⁸ Outliers, as defined for the previous data sets, were removed for the models presented in table 14 and included for the models in table 15. Thus, the table 15 models were each based on the full set of 34 origin zones. These models represent the

broadest scope of visitor participation data for the 10 campgrounds analyzed in this study.

Various independent variables representing socio-demographic characteristics and site substitutes entered some of the equations with statistically viable coefficients, but typically only the price variable entered the models (and always with the expected negative sign). Income was included, with a positive sign, in 2 of the models for Christopher Creek campground (tables 14 and 15). Age was included, with a positive sign, in the models for 3 campgrounds (table 12). And substitute site costs were included in the models of 3 campgrounds. Average education, in years, did not appear as a significant independent variable in any of the estimated equations.

⁸ Actually, because zero values for the dependent variable cannot be used in a semi-log dependent functional form, a value of 1 was substituted for visits in those cases. Some other, smaller number arbitrarily close to zero (e.g., 0.001) could be selected, but it would not, when converted to a per capita value, make the analysis more accurate; the bias of unrealistic, fractional visits is introduced. Furthermore, as per capita visits approach zero, the logarithmic value of per capita visits approaches negative infinity, unrealistically skewing a few data points.

Table 13.—Regression statistics by campground using only origin zones with actual visits recorded by envelopes, outliers included.

Campground	Independent variable coefficients ^a					n	Adj. R ²	F
	Constant	Price	Income	Age	Substitutes ^b			
Ashurst Lake	-7.659 (-8.985)*	-.053 (-5.626)*		.090 (3.244)*		29	.58	20.00*
Canyon Point ^d						32		
Christopher Creek ^c	-5.200 (-9.883)*	-.054 (-2.889)*				23	.25	8.34*
Dairy Springs ^d						29		
Dogtown Reservoir ^c	-5.902 (-12.616)*	-.067 (-6.711)*			.057(CC) (4.452)*	32	.61	25.24*
Kaibab Lake	-6.586 (-12.577)*	-.056 (-4.596)*			.064(CC) (4.481)*	29	.50	14.76*
Pine Grove	-5.627 (-14.760)*	-.031 (-2.962)*				29	.22	8.77*
Rock Crossing ^d						30		
Spillway	-5.442 (-9.326)*	-.040 (-2.437)*				26	.16	5.94*
Whitehorse Lake	-6.244 (-6.195)*	-.069 (-7.213)*		.058 (1.876) [#]	.039(SP) (3.282)*	32	.66	20.72*

^a t'-statistics in parentheses, significance level: * = .01; + = .05; # = .10

^b Substitute campground noted in parentheses: SP = Spillway; CC = Christopher Creek.

^c Repeated from Table 12 (no outliers).

^d No equation could be estimated.

Table 14.—Regression statistics by campground, including zero-visit origin zones, outliers excluded.

Campground	Independent variable coefficients ^a					n	Adj. R ²	F
	Constant	Price	Income	Age	Substitutes ^b			
Ashurst Lake	-5.253 (-13.832)*	-.048 (-4.421)*				34	.36	19.55*
Canyon Point	-5.166 (-12.415)*	-.043 (-3.750)*				30	.31	14.06*
Christopher Creek	-8.030 (-7.284)*	-.046 (-3.015)*	.00022 (2.636)* ⁺			32	.38	10.31*
Dairy Springs	-5.678 (-14.883)*	-.043 (-3.708)*				32	.29	13.75*
Dogtown Reservoir	-5.929 (-11.707)*	-.069 (-6.413)*			.057(CC) (4.175)*	33	.58	22.88*
Kaibab Lake	-6.629 (-13.259)*	-.062 (-5.737)*			.061(CC) (4.468)*	33	.54	19.94*
Pine Grove	-5.538 (-13.575)*	-.033 (-3.056)*				28	.24	9.34*
Rock Crossing	-5.648 (-17.676)*	-.047 (-4.673)*				30	.42	21.84*
Spillway	-4.917 (-10.364)*	-.068 (-4.804)*				31	.42	23.08*
Whitehorse Lake	-7.503 (-8.315)*	-.067 (-7.424)*		.099 (3.526)*	.033(SP) (2.811)*	33	.70	25.37*

^a t'-statistics in parentheses, significance level: * = .01; + = .05

^b Substitute campground noted in parentheses: SP = Spillway; CC = Christopher Creek.

Table 15.—Regression statistics by campground, including zero-visit origin zones, outliers included.

Campground	Independent variable coefficients ^a					n	Adj. R ²	F
	Constant	Price	Income	Age	Substitutes ^b			
Ashurst Lake ^d	-5.253 (-13.832)*	-.048 (-4.421)*				34	.36	19.55*
Canyon Point	-5.300 (-9.512)*	-.030 (-1.997) [#]				34	.08	3.99 [#]
Christopher Creek	-8.207 (-7.839)*	-.046 (-3.114)*	.00023 (3.006)*			34	.40	12.01*
Dairy Springs ^c						34		
Dogtown Reservoir	-5.955 (-11.983)*	-.069 (-6.486)*			.059(CC) (4.380)*	34	.58	23.66*
Kaibab Lake	-6.780 (-12.190)*	-.061 (-5.042)*			.069(CC) (4.508)*	34	.49	16.91*
Pine Grove ^c						34		
Rock Crossing	-5.912 (-12.549)*	-.028 (-1.944) [#]				34	.08	3.78 [#]
Spillway ^c						34		
Whitehorse Lake	-7.461 (-7.177)*	-.067 (-6.427)*		.092 (2.840)*	.040(SP) (3.013)*	34	.62	18.75*

^at-statistics in parentheses, significance level: * = .01; + = .05; # = .10

^bSubstitute campground noted in parentheses: SP = Spillway; CC = Christopher Creek.

^cNo equation could be estimated.

^dRepeated from table 14 (no outliers).

The positive sign on coefficients for substitute sites indicates that as the cost of visiting a substitute campground increases, the visitation at the campground being modeled will increase. As shown in tables 12-15, Christopher Creek campground enters as a substitute for both Dogtown Reservoir and Kaibab Lake campgrounds, and Spillway enters as a substitute for Whitehorse campground. While these results are plausible, in terms of the campgrounds' respective characteristics, they in fact depend only on the "price," or travel cost, of using the substitute. In the regression analysis, campgrounds may enter the model as substitutes for one another when the travel distance from the visitors' origin to the substitute is neither "too near" to, nor "too far" from, the travel distance from the origin to the campground being modeled. Substitutes whose distances are "too near" to those of the modeled campground became perfect substitutes and cannot be properly treated as independent campgrounds in the analysis. Those that are "too far" are not substitutes at all. Most of the campgrounds made available as substitutes were probably too close to each other, relative to the major origin zones, to enter as substitute sites in the models.

Visitor responses to the on-site survey indicate that the 10 campgrounds under study are less than perfect substitutes for one another in a qualitative sense. The substitute site independent variables that entered three of the models did so because of the quantitative criterion (distance), not a similarity of qualitative characteristics.

With the restricted data sets used to produce the table 12 models (no zero-visit or outlier origin zones), usable equations were obtained for each of the 10 campgrounds. The models represented data for between 23 and 32 of the 34 potential origin zones. Adjusted R²s of these models varied from 0.25 to 0.75. When "outlier" zones were included (table 13), sample sizes increased for 8 of the 10 campgrounds by from 1 to 4 zones. Of these 8 campgrounds, viable estimates of demand could not be obtained for 3 of them (Canyon Point, Dairy Springs, and Rock Crossing campgrounds). For the remaining 5 campgrounds, model significance and adjusted R² typically fell (the biggest exception being Ashurst Lake, where they both rose).

When zero-visit origin zones were included but outlier zones were excluded (table 14), the individual campground data sets included from 28 to (in one case) all of the 34 zones. Usable models were obtained for each campground. Model significance levels and R²s were different from those developed without zero-visit origin zones included (table 12), with statistics for some campgrounds improving and for others lowering. But overall there were no consistent differences between the two sets of equations. Finally, when "outlier" zones were included (table 15), sample size (of course) increased to 34 for all campgrounds. Of the 9 campgrounds for which the number of zones increased by including the outliers (comparing tables 14 and 15), viable models could not be estimated for 3, significance levels and R² values changed a moderate amount (up or down) for 4,

and significance levels and R^2 fell substantially for 2 (Canyon Point and Rock Crossing).

Clearly, the inclusion of outlier origins, as defined for this study, has a detrimental impact on the estimation of demand using TCM. Whether zero-visit origin zones were included or not, inclusion of the outlier zones produced insignificant models for some campgrounds and markedly lowered the significance of others.

Estimates of Consumer Surplus

The estimates of total consumer surplus and consumer surplus per person-visit for each campground and each model type are presented in tables 16 through 19. The

estimated number of total visits made by individuals, as predicted by each demand model, are also included in each table. The values in these tables correspond to the models presented in tables 12 through 15, respectively.

The change in estimated visitation that results from removing outlier origin zones is apparent in the change in total consumer surplus, as one compares the estimates of table 16 (no outliers) with those of table 17 (outliers in), or those of table 18 with those of table 19. Among those campgrounds with outlier origins for which models could be estimated, visitation and total consumer surplus were larger when estimated with outliers in. Tables 16 and 17 serve as an example. When outliers were included, visitation and total consumer surplus increased by 6% and 2%,

Table 16.—Estimated visits and consumer surplus for table 12 models (zero-visit origins excluded, outliers excluded, 1985 dollars).

Campground	Total consumer surplus \$	Person-visits	Consumer surplus per person per visit ^a \$
Ashurst Lake	53,955	2,773	19.46
Canyon Point	111,659	5,200	21.47
Christopher Creek	72,608	3,940	18.43
Dairy Springs	53,982	2,499	21.60
Dogtown Reservoir	42,288	2,849	14.84
Kaibab Lake	43,814	2,539	17.26
Pine Grove	86,389	2,948	29.30
Rock Crossing	48,771	2,281	21.38
Spillway	72,009	3,474	20.73
Whitehorse Lake	95,419	6,564	14.54

^a Calculated for each campground using the estimated total consumer surplus divided by the estimated total person-visits.

Table 17.—Estimated visits and consumer surplus for table 13 models (zero-visit origins excluded, outliers included, 1985 dollars).

Campground	Total consumer surplus \$	Person-visits	Consumer surplus per person per visit ^a \$
Ashurst Lake	55,153	2,946	18.72
Canyon Point ^c			
Christopher Creek ^b	72,608	3,940	18.43
Dairy Springs ^c			
Dogtown Reservoir ^b	42,288	2,849	14.84
Kaibab Lake	49,217	2,791	17.63
Pine Grove	99,616	3,082	32.32
Rock Crossing ^c			
Spillway	92,268	3,668	25.16
Whitehorse Lake	99,785	6,858	14.55

^a Calculated for each campground using the estimated total consumer surplus divided by the estimated total person-visits.

^b Same model as table 16.

^c No equation could be estimated.

Table 18.—Estimated visits and consumer surplus for table 14 models (zero-visit origins included, outliers excluded, 1985 dollars).

Campground	Total consumer surplus \$	Person-visits	Consumer surplus per person per visit ^a \$
Ashurst Lake	54,857	2,653	20.67
Canyon Point	96,769	4,197	23.06
Christopher Creek	108,100	5,037	21.46
Dairy Springs	48,337	2,088	23.15
Dogtown Reservoir	38,469	2,675	14.38
Kaibab Lake	32,529	2,048	15.88
Pine Grove	86,887	2,920	29.75
Rock Crossing	47,546	2,281	20.84
Spillway	43,893	3,020	14.54
Whitehorse Lake	94,380	6,344	14.88

^aCalculated for each campground using the estimated total consumer surplus divided by the estimated total person-visits.

Table 19.—Estimated visits and consumer surplus for table 15 models (zero-visit origins included, outliers included, 1985 dollars).

Campground	Total consumer surplus \$	Person-visits	Consumer surplus per person per visit ^a \$
Ashurst Lake ^c	54,857	2,653	20.67
Canyon Point	171,084	5,200	32.90
Christopher Creek	118,135	5,484	21.54
Dairy Springs ^b			
Dogtown Reservoir	39,031	2,710	14.40
Kaibab Lake	36,264	2,250	16.11
Pine Grove ^b			
Rock Crossing	104,278	2,966	35.15
Spillway ^b			
Whitehorse Lake	99,282	6,654	14.92

^aCalculated for each campground using the estimated total consumer surplus divided by the estimated total person-visits.

^bNo equation could be estimated.

^cSame model as table 18.

respectively, for Ashurst Lake, and by 10% and 12% for Kaibab Lake. The outliers tend to produce unrealistic increases in demand (more visits as costs increase), leading to high and probably inaccurate surplus estimates.

With outlier origin zones excluded, total consumer surplus estimates were smaller when zero-visit zones were included (table 18) than when such zones were excluded (table 16) for all but 3 campgrounds. Among the 7 campgrounds for which the estimate of total consumer surplus decreased when zero-visit origin zones were included, the decrease ranged from 3% (Rock Crossing) to 39% (Spillway) and averaged 16%. Among the 3 campgrounds where consumer surplus increased with inclusion of the zero-

visit origin zones, the increase was less than 2% for two of them (Ashurst Lake and Pine Grove). The third, Christopher Creek, had no outliers; rather, the increase in consumer surplus was due to a change in the demand model, as seen by comparing tables 13 and 14. The model for Christopher Creek in table 14 includes an income variable that apparently makes the equation more price inelastic; more total person-trips are estimated to occur.

The underlying reason for this apparent anomaly in model changes due to adding zero-visit origin zones may lie in the necessity of using 1's in place of zeros for origins with no visits. Depending on the locations of origins providing zero visits to a campground, substituting 1's for

those origins with relatively small populations has a greater impact on estimated total visitation per capita than substitutions for origins with larger populations.

One measure of the reliability of the estimated demand functions is how accurately they predict actual visitation. Total person-visits were predicted for each campground model using the RMM Software (Arnold, et al. 1991), assuming no added visitor costs. Comparison of these predicted visits, listed in tables 16 through 19, with the total estimated visitation for each campground in table 10 shows that the estimated person-visits of table 18, based on including all origin zones except outliers, are most accurate. The estimates approximate measured visits for 8 of the 10 campgrounds. Only the table 18 values for Spillway and Canyon Point campgrounds vary considerably from those in table 10. Based on this criterion, one would conclude that models in table 14 and the corresponding consumer surplus values in table 18 indicate, overall, the most stable demand functions.

The differences in consumer surplus between campgrounds, assuming equally dependable demand functions, represent differences in economic value. The estimates of consumer surplus per person per visit represent the amount of money the average visitor would be willing to pay above what he or she actually paid to use that campground, rather than go somewhere else or stay home. Thus, for example, Pine Grove campground appears to be, in willingness-to-

pay terms, twice as valuable per visit as Whitehorse Lake campground, all else equal (table 18).

In part, the differences in estimated demand functions, and corresponding differences in surplus values, are due to the nature of visitors to a particular campground. For example, the on-site survey revealed that upon comparing visitors of Pine Grove campground and Whitehorse campground, Pine Grove visitors were more likely to be retired, to travel a greater distance, to visit multiple sites on their trip, to prefer Pine Grove over any potential substitute sites, and to stay longer. Whitehorse visitors tended to camp on weekends, returning to jobs during the week. However, care must be exercised in such comparisons because they are based on models of different reliability. The reliability of the estimated demand function for Whitehorse campground appears to be considerably greater than that of Pine Grove model (table 14).

In order to provide precision estimates for the values in table 18, sensitivity intervals were calculated for each consumer surplus estimate. Consumer surplus was re-estimated using the upper and lower confidence limits ($p \pm 0.05$) on the regression coefficient for the cost variable in each model in table 14. These "high" and "low" estimates are shown in table 20, along with the corresponding estimates of upper and lower person-visits. The true consumer surplus values will fall within the high and low estimates 95% of the time.

Table 20.—Estimated sensitivity intervals for visits and consumer surplus estimates in table 18.

Campground	High and low total consumer surplus \$	High and low person- visits	High and low consumer surplus per person per Visit ^a \$
Ashurst Lake	194,654	5,172	37.64
	20,350	1,425	14.28
Canyon Point	409,754	7,966	51.44
	34,014	2,277	14.94
Christopher Creek	706,228	10,449	67.59
	35,947	2,799	12.84
Dairy Springs	230,065	4,391	52.39
	15,488	1,046	14.81
Dogtown Reservoir	121,828	5,688	21.42
	14,896	1,373	10.85
Kaibab Lake	110,983	4,429	25.06
	12,067	1,041	11.59
Pine Grove	584,858	6,342	92.22
	24,713	1,393	17.74
Rock Crossing	150,774	4,014	37.56
	19,183	1,327	14.46
Spillway	159,623	6,221	25.66
	15,344	1,506	10.19
Whitehorse Lake	228,722	11,004	20.79
	39,484	3,376	11.70

^a Calculated for each campground using the estimated total consumer surplus divided by the estimated total person-visits.

Multiple Destination Trips

Recall that the envelope data do not distinguish multi-destination trips. Data obtained from the on-site interview sample at each campground provided information to complement the envelope-based data sets. Visitors were asked if the site where they were being interviewed was the only recreation stop on their current trip. If the answer was "no," they were further queried about the nature of their trip, what other stops had been or would be made, and for how long. From these responses, an estimate of the number of visitors at each campground who were on a multiple destination trip was obtained. The responses also indicated whether the study campgrounds were potential substitutes for each other.

The interviews indicated that between 0% (Rock Crossing) and 16% (Dairy Springs) of the Arizona visitors to the study campgrounds were on multiple destination trips (table 21, column 2). Those sites with a higher proportion of multi-destination trips tended to be those near major travel routes to popular destinations (Kaibab Lake) or sites favored by retired visitors (Canyon Point, Dairy Springs, and Pine Grove).

The interview data do not permit a determination of the percentage of multiple destination visitors from each of the study origin zones, because not all visitor origin zones for this study were represented by respondents to the on-site

Table 21.—Consumer surplus and person-visits adjusted for multiple destination trips and incomplete envelopes (1985 dollars).

Campground	Multi-destination trips %	Lower bound total consumer surplus ^a \$	Adjusted total person-visits ^b	Adjusted lower bound total consumer surplus ^c \$
Ashurst Lake	8	50,468	2,446	50,559
Canyon Point	11	86,124	6,438	148,460
Christopher Creek	9	98,371	6,219	133,460
Dairy Springs	16	40,603	2,141	49,564
Dogtown Reservoir	3	37,315	3,141	45,168
Kaibab Lake	10	29,276	2,343	37,207
Pine Grove	12	76,461	3,172	94,367
Rock Crossing	0	47,546	2,758	57,477
Spillway	4	42,137	5,185	75,390
Whitehorse Lake	5	89,661	6,868	102,196

^aTable 18, Column 2, values reduced by the percentage of multi-destination trips.

^bTable 9, column 6, household visits reduced by the percentage multi-destination trips; adjusted by table 9, column 2/column 3; and expanded to a person-visit basis based on party size listed in table 11, column 5.

interviews. However, it was possible to analyze the responses for the origin zones included in the interview data, to determine whether there were systematic relationships between multiple destination trips and distance traveled, zonal population, average income, or average age. If a systematic relationship were found, it would indicate that the envelope-based demand functions were biased, to an unknown extent. The inclusion of multiple destination visits would unpredictably and inaccurately weight relationships among zones. For example, visitors from more distant zones, or visitors from zones with higher average income, may more likely be on multiple destination trips. This would be expected to inflate estimates of value, but by an undeterminable amount, given the lack of information on multiple destination visitors by origin zone, which is typical of envelope data.

But, if no systematic relationship existed, it could then be assumed that the economic models and corresponding estimates of value per visit would be the same whether visitors on multiple destination trips were included in the analysis or not. Aggregate estimates of value for each campground, of course, would be greater with multiple destination visitors included.

Using on-site interview data for each campground, the percentage of multiple destination trips from each origin zone was regressed on one-way miles, from origin to campground; on average zonal age, education, income, and on zonal population. This was done twice, once including all zones for which envelope data showed any visits, and once including only those zones for which interview data showed trips. Table 22 displays the results of these regressions.

Distance was not a significant variable (based on a t-value of 0.05) for any campground regressions based on the full set of origin zones. Distance was a significant independent variable only once, for Canyon Point campground, using only interview-based origins. The positive coefficient indicates the expected relationship; as distance increases, multiple destination trips increase. Increasing zonal age also appears to be a predictor of more multiple destination trips, at least for 2 campgrounds (table 22). Three other campgrounds show increasing population to be correlated with multiple destination trips, but the reason for this is unclear.

As a further test of potential unaccountable bias in the demand models due to multiple destination trips, we performed a simplified version of the analysis of distance-ordered residuals proposed by Smith and Kopp (1980). For each campground we produced a scatterplot of values relating the studentized residuals of the campground model to the ordered (low to high) distances from each origin to the campground. No obvious pattern or relationship was revealed in the scatterplots.

These results suggest that no systematic relationship exists between the origin zones used in this study and likelihood of multiple destination trips, indicating that the demand functions correctly predict value per visit. The inflated estimate of total consumer surplus that results from the involuntary inclusion of multiple destination visitors in the analysis when using fee envelope data (in tables 16-19) can be reduced by the proportion of multiple destination trips made to the site to yield a lower bound on the estimate of consumer surplus.

Table 22.—Summary of multi-destination analysis of 1985 Arizona campground interview data^a

Camp-ground	Number of origin zones		Regression models ^b			
	All zones ^c	with ^d trips	All zones ^c		Zones w/trips ^d	
			R ²	variables	R ²	variables
Ashurst Lake	30	14	.03	miles	-.08	miles
Canyon Point	29	12	-.03	miles	.86	miles**(+)
Christopher Creek	23	12	.22	miles (+) age*(+)	.71	miles (+) age**(+)
Dairy Springs	27	12	-.03	miles	-.10	miles
Dogtown Reservoir	33	13	.21	miles (-) pop* (+)	-.08	miles
Kaibab Lake	29	18	.01	miles	.31	miles (-) pop* (+)
Pine Grove	23	8	-.05	miles	-.03	miles
Rock Crossing	28	10				
Spillway	25	12	.32	miles (-) pop** (+)	.25	miles (-) pop* (+)
Whitehorse Lake	31	19	.09	miles (+)	-.03	miles
All	278	130	.01	miles (+) age* (+)	.04	miles (+) age* (+)

^a Data include only Arizona residents.

^b R² is adjusted for degrees of freedom; * = significant at 0.05; ** = significant at 0.01; sign of coefficient in parentheses.

^c All origin zones with positive visits, based on the envelope data.

^d All origin zones with positive visits, based on the interview data.

Including multiple destination trips in the estimation of total consumer surplus (as in tables 16-19) would yield upper bounds on the true surplus enjoyed by Arizona visitors to the campgrounds. This is because any visitor whose trip included more recreation destinations than the campground where the fee envelope was obtained would have the total value of his or her trip experience attributed to that campground. Such an allocation of recreation value would only be valid if no part of the trip beyond this study campground added net value to the trip. In fact, in most such cases of joint production, it is probably more accurate to assume that all sites contribute something to the total value of the trip. Our recommended solution to this problem, to reduce the consumer surplus estimates by the percentage of visitors who were on multiple destination trips, provides the lower bound on the total value estimates.

In table 21, column 3, the estimated total consumer surplus values reported in table 18 are shown reduced by the percentage of multiple destination visitors, as determined in the on-site interviews. By attributing no value to visits by campers on multi-destination trips, this adjustment shows the estimated lower bound on value for each campground. Among the 9 campgrounds with multi-destination visitors, the upper bound ranges from 3% (\$1,154) to 19% (\$7,734) greater than the lower bound. The mean increase in estimated value from lower to upper bound is 9.7%.

Other Problems With Incomplete Data

A second adjustment to the results involves a correction for the true number of Arizona visitors to the study campgrounds. Recall that although visits listed in table 9 were adjusted upward to correct for the fact that not all envelopes included license plate number, purchase date, and number of days paid, there was no adjustment for envelopes that were missing a zip code. Actually, more than 3,000 envelopes with Arizona license plate numbers lacked information on the zip code and could not be used in determining origin zones (compare columns 2 and 3, table 9). Thus, they were not included in the visitation data base used to estimate the demand models for each campground. Assuming a random distribution of these envelopes across origin zones, total visits at each campground could be further adjusted upward and then expanded to a person-visit basis.

The adjusted visits in table 9, column 6, were reduced by the percentage of multiple destination trips and then adjusted upward by the ratio of column 2 to column 3 of table 9. This latter adjustment corrects the visitation data to account for all Arizona visits to each campground. These adjusted visits are then expanded by the average party size for each campground and reported in column 4 of table 21. Finally, these adjusted person-visits were multiplied by the average (per person per visit) consumer surplus esti-

mates, reported in table 18, to derive the adjusted total consumer surplus listed in column 5 of table 21. The increase in lower bound value (from column 3 to column 5, table 21) with this adjustment ranged from 0.2% (\$91) to 79% (\$33,253), averaging 32%.

These adjustments are predicated on the assumptions that (1) all Arizona visitors to the study campgrounds, including those on multiple destination trips and those who failed to complete all categories of their fee envelopes, were distributed randomly among the study origin zones; and (2) the recreation behavior of visitors who did not complete their fee envelopes was no different than those who did. None of the information provided on the envelopes or collected during the on-site interviews would suggest a violation of these assumptions.

An Application of the Results

The total consumer surplus estimates reported in table 18 and table 21 represent the net benefit that the campground visitors receive. These measures can be used along with related economic information to estimate the net benefit of the campgrounds to society, which can in turn be used by forest managers and planners in deciding how to allocate forest resources.

Simple benefit-cost analyses for two of the study campgrounds, Whitehorse Lake and Pine Grove, will show how the results of this study can be used to examine the net benefits to society of using certain forest resources to provide similar recreational opportunities in other locations. The two campgrounds were selected to represent a range of facilities, a range of recreation visitors, and, in some measure, a range of reliability in the value estimates.

In table 23, the salient characteristics of each campground and the relevant costs and revenues for the simple benefit-cost analysis are presented. No change in the rate of visitation is considered, nor is any change in recreation substitutes. Other external influences, such as changes in social and demographic factors, are also assumed to remain constant.

The attributes noted in table 23 for each campground are either existing or would be included if either facility were reconstructed to an equivalent service level and capacity. No individual water or electrical hookups are provided, and no sewage dump facility is provided. The reconstructed facilities are assumed to have a 30-year life. This analysis provides several interesting results. First, the annual operation and maintenance costs are similar to the annual fee revenues for the two campgrounds. Second, the total cost (construction plus operation and maintenance) would far exceed the fee revenue if all were expressed on a common (e.g., annualized) basis; that is, revenues do not cover costs at these campgrounds. Third, the total benefit to society, including the consumer surplus, clearly outweighs the costs. The associated benefit-cost ratios are 1.27 for

Table 23.—Simple benefit-cost analysis of two study campgrounds (1985 dollars).

Attribute	Whitehorse Lake	Pine Grove
Campsites (table and grill)	85	46
Toilets (six seat)	4	2
Water system faucets	25	15
Surfaced roads and parking (incl. day use)	Yes	Yes
Surfaced trails	Yes	Yes
Fencing	Yes	Yes
Construction cost ^a	\$1,477,000	\$828,000
Annual operation and maintenance cost ^a	\$25,000	\$20,000
Annual fee revenues ^b	\$30,824	\$18,912
Annual consumer surplus ^c	\$102,196	\$94,367
Discounted net returns for 30 years ^d	\$1,868,000	\$1,613,000
Social net benefit	\$391,000	\$785,000
Benefit-cost ratio	1.27	1.95

^aConstruction, operation, and maintenance costs are estimated from information obtained for each campground from the Kaibab and Coconino National Forests, respectively.

^bAnnual revenues are derived from the number of expanded Arizona visits in 1985 (table 9, column 6 x column 2/column 3) multiplied by the campground fee (table 11, column 4) multiplied by the average length of stay (table 4, column 5).

^cFrom table 21, column 5, which is a lower bound because the value from multi-destination visitors is not included.

^dAnnual fee revenues minus annual operation and maintenance costs plus annual total consumer surplus estimates discounted at 4% for 30 years, the assumed life of the facility if reconstructed in 1985.

Whitehorse Lake and 1.95 for Pine Grove, confirming a positive return on the investment.

The social net benefit figure shown for each campground is an estimate of the net value of forest resources used for campground recreation, of the cost of construction and annual operation and maintenance. These net social benefits could be compared with the benefits of competing uses of these forest resources, such as for commercial timber harvest or livestock forage production, to help decide how other forest areas should be used. Alternatively, the opportunity cost of the campground, in terms of the net value of foregone timber harvest and livestock production from the campground area and the surrounding view shed, could be added to the construction and annual operation and maintenance costs to recompute the benefit-cost ratio.

The analyses also offer the possibility of comparing the two campgrounds. It is clear that, although Pine Grove operates slightly in the red and Whitehorse Lake operates in the black, based on annual costs and revenues, Pine Grove provides about twice the net benefit of Whitehorse Lake. Furthermore, Pine Grove provides almost four times the net social benefit that Whitehorse Lake does on a per-campsite basis. However, one cannot simply compare the

social net benefit values of the two campgrounds and conclude that one is superior. First, the two campgrounds are different in the recreational experiences they provide (although, like apples and oranges, they may serve as partial substitutes for each other). Second, the estimates of consumer surplus for each are tentative. Also, the simplified structure of the benefit-cost analysis calls for caution in the use of these results. And, in any case, the analyses show that both campgrounds contribute positively to the nation's social welfare.

Conclusions

Given the characteristics and circumstances of forest land recreation in much of the western United States, including vast land areas and scattered populations, a travel-based valuation method is complex and somewhat difficult to apply correctly. This is especially so when a relatively low-cost but theoretically sound and easy to apply method is desired. However, the zonal TCM using campground fee envelope information or a comparable data source, appears to be a viable approach.

In applying the TCM, a conscientious effort must be made to define appropriate origin zones and to adjust data and results to account for certain limitations in the data sources. Origin zones for application of the zonal travel cost approach must be defined to assure that the probability of participation (visitation) to the recreation site is accurately reflected. This typically necessitates including origin zones that contributed no observed visits when it is reasonable to expect that they would contribute visits at some time. It is also necessary to define a market boundary, or to set a distance limit, beyond which no zones will be considered in the analysis. And, it may be necessary to eliminate "outlier" zones from the analysis, or to combine origins into zones, provided that homogeneity in visitor socio-demographic characteristics is maintained. In every instance, a bias diminishing the reliability of the results may be associated with the effort. Therefore, a careful consideration of the possible effects of ignoring or eliminating origins in defining a market area for analysis is important. We recommend that estimates of demand and consumer surplus be made with several data sets, with and without questionable origins, to test the sensitivity and sensibility of the results.

Using a data source like fee envelopes imposes limits on important information for travel cost analysis. The actual number of visits per origin per time period must be estimated from an incomplete source. The characteristics of visitors' trips, such as the number of recreation sites visited per trip, must be assessed indirectly. After estimating demand models from visitation data linked to zip codes, we adjusted the estimates of consumer surplus to account for multiple destination visits and to reflect the true number of Arizona visitors to each campground, as revealed by the total fee

envelopes collected. We had an unusual advantage in having certain "on-site" information with which to evaluate and adjust the envelope-based data. If the percentage of multiple destination visits cannot be determined, the analyst will estimate the upper bound of consumer surplus. Our on-site survey information suggests that recreation sites near major travel routes to popular destinations, or sites that are used extensively by retired visitors, are the most likely to be stops on multi-destination trips. Overestimation of the true value of consumer surplus derived from envelope-based zonal TCM is more likely at such sites.

Other recreational circumstances may well show a stronger relation between distance and multiple destination trips, as shown, for example, in Smith and Kopp (1980). In such cases, if multiple destination trips can be identified, they should be removed from the data base until the demand models are estimated. With these unbiased models, total consumer surplus should then be estimated with multiple destination trips included so that the real value of these trips is not lost. Sorg et al. (1984) found that the consumer surplus for multiple destination visitors to a site was higher than the average consumer surplus of single destination visitors to that site (the former visitors presumably received the same experience as the latter, but at a lower cost).

The adjustments to data and to results carried out and described in this study demonstrate one approach with a reasonable outcome. Other situations—representing non-campground recreation experiences or locations such as wilderness or rafting experiences governed by permits—can be treated within this general method by other data adjustments. Any adjustments, however, should be guided by two decision criteria: data adjustments should minimize bias in the results, and value estimates should be conservative. The first criterion requires the analyst to look for, or test for, nonrandom influences on results that data adjustments may cause. The second criterion suggests that minimum or lower bounds on value estimates should be maintained unless statistical confidence merits more liberal treatment of both data and results.

With the availability of personal computer-based software for travel cost analysis and relatively inexpensive data, it is reasonable to develop estimates of economic value for some nonmarketed forest activities. These estimates can be used, with appropriate caution, to improve the basis for forest management decisions.

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Data from registration fee envelopes collected at ten forest campgrounds were used with the travel cost method to estimate the economic value of recreation at the sites. Additional data from interviews with a subset of the visitors were used to further assess the utility of envelope data for application of the travel cost model.

Keywords: travel cost method, campground, campground fees, consumer surplus, campground visitors, economic value, forest recreation, registration envelopes

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Research programs at the Rocky Mountain Station are coordinated with area universities and with other institutions. Many studies are conducted on a cooperative basis to accelerate solutions to problems involving range, water, wildlife and fish habitat, human and community development, timber, recreation, protection, and multiresource evaluation.

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